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Determinants of Stock Market Index in India

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Abstract
Investigating the factors affects the stock markets has gained attention worldwide and is a well-regarded subject in finance. The study examines the determinants of stock market index in India. In particular, the aim of the paper is to analyse the interaction between macro-economic variables and Indian stock market indices. Monthly data of NIFTY500 index NAV, consumer price index (CPI), index for industrial production (IIP), USD-INR exchange rate, asset under management (AUM), and Treasury bill rate were collected for the period November 2005 to April 2024 and applied Johansen (1991) cointegration technique to examine the long run relationship between these variables. Short run relationship was estimated by the Vector Error correction Model. The results of the study shows that there exists long run relationship between stock market index, and other fundamental economic variables, *viz*. CPI, IIP, USD -INR exchange rate and rate of interest in India. The normalized coefficients of the cointegrating vector suggest that while AUM positively and significantly influence nifty500 index, the exchange rate has negative and significant effects on it. The results of the study would be useful for predicting the stock market index in India that can further help in making better investment decisions.

Keywords: Stock markets, consumer price index, industrial production, exchange rate, asset under management, and treasury bill

Introduction
Investment in stock markets is one of the widely trusted means among people as it is considered to be the good source of earning income. However, whether the expected returns from stock market investment will be stable is still questionable as these returns are affected by macro-economic variables apart from the operational activities of business enterprises. Macro-economic variables are directly or indirectly connected to the stock prices. Government policies, economic policies, domestic and international commercial contacts and changes in banking regulations often induces the economic factors. This creates large fluctuations in the performance of stock exchanges and leads to uncertainty in estimating the future stock market returns. In this digital era companies and investors prefer to accumulate their surplus money on the shares of top companies. Business men and financial experts watching the share price movements affected by economic factors to minimize the loss or adjust the portfolio in better manner. (Hasan & Muhammad Tariq Javed, 2009) [9] argue that all macro-economic deviations should be priced by market because discount and anticipated cash flows are induced by economic variables. (Andersen Sandvik *et al*., 2016) [2] discuss the efficiency of market information that the impact of macro-economic variables should be considered efficiently when stock returns had displayed the significant level of influence by economic factors both positive and negative aspects. The performance of the market or a definite segment can be scrutinized by the stock market indices and it provides an idea to the investors about the future price changes. It requires unvarying information to both individual and institutional investors which urge the evaluation of macro-economic indicators to predict the stock returns, (Prieto & Lee, 2019) [20]. Emerging country like India functioning of stock exchanges embraces the development in capital market and it leads to the stable economic development. Understanding the status and its attributes of different macro-economic variables in predicting the stock returns is necessity in many ways. (Keswani *et al*., 2024) [12] have listed the reasons for requirement of research studies on the association of stock returns and economic factors.

The reasons cited by the study are to assist individual and institutions in investment decision making, providing perceptions into how inflation, exchange rate and interest rates impact stock prices, mitigating the risks, role in framing different policies and valuing its significance etc. The present paper is an attempt to examine the inter-linkages between the fundamental economic variables and stock market index (SMI) for the Indian economy. After the Introduction part, this paper has been divided in to five sections, Section 2 describes the literature review, Section 3 explains the model utilized in this study. Section 4 elucidates the data and econometric methodology, Section 5 gives the empirical results and discussion and Section 6 concludes the study.

Literature Review

The existing studies on equity returns analyzed the impact of several macro-economic variables on SMI in different dynamics and concluded mixed results. It makes the presumption that findings of the research depend upon the period of the study, the data and the factors considered. Several studies, including (Haq & Masih, 2018 [8]; Hasan & Muhammad Tariq Javed, 2009 [9]; Kandir, 2008 [11]; J Khan & Khan, 2018 [13]; Md. FH Khan & Billah, 2023 [14]; Osisanwo *et al*., 2012 [17]; Peiró, 2016 [19]; Prieto & Lee, 2019) [20], have found the long-term connection between stock prices and economic factors. (Haq & Masih, 2018) [8] employed co-integration and Vector Error Correction Model (VECM) and Variance decomposition to investigate the relation between industrial production index, wholesale price index, exchange rates and the Indian SMI. The study found long run connection between the SMI and macroeconomic variables. Stock prices were influenced positively by exchange rates and industrial production while adversely connected with inflation. (Andersen Sandvik *et al*., 2016) [2] examined the monthly data of Oslo all-share index and the certain macroeconomic aspects from January 2001 to June 2016 by applying the VECM. The authors found the presence of a long-run relationship between the variables. (Keswani *et al*., 2024) [12] investigated the association between Indian stock prices and the designated macroeconomic factors and displayed that the stock market of India has a statistically significant long-term relation with gross domestic product, disposable income and, the participation of foreign institutional investors.

The effect of commodity prices and the macroeconomic variables on the Korean' and Japanese' stock market performance was analysed by (Prieto & Lee, 2019) [20] using the VECM and revealed that the effect of both commodity prices and macro-economic variables echoes on the Korean and Japanese stock market indices. Additionally, they found long term co-integration existed between GDP growth, inflation rate, interest rate, exchange rate, crude oil WTI price, gold price and SMI. (J. Khan & Khan, 2018) [13] investigated the effect of money supply, exchange rate, and interest rate on stock prices in Pakistan and found presence of significant long-term association and insignificant relationship existed in short term period. The association of Dhaka stock exchange index return with exchange rate, inflation, and money supply was examined using appropriate statistical tests by (Md. FH Khan & Billah, 2023) [14] and established the strong correlation between macroeconomic variables and stock market return. In the three main European economies of France, Germany, and the United Kingdom, (Peiró, 2016) [19] explored the connection between stock prices, production, and interest rates, and he concluded that variables have an effect on the determination of stock prices. (Kandir, 2008) [11] analyzed the role of seven macroeconomic factors in explaining Turkish stock returns with the statistical tool of multiple regression model. He concludes that portfolio returns highly influenced by exchange rate, world market return, interest rate and no significant effect by inflation, industrial production, money supply and oil prices on stock prices. (Hasan & Muhammad Tariq Javed, 2009) [9] employed the VAR framework on monthly data to analyse the relationship of industrial production index, consumer price index, money supply, exchange rate, foreign portfolio investment, Treasury bill rates and oil prices with equity market returns. The study found long run connection between macroeconomic factors and equity returns. The result of a study done by (Osisanwo *et al*., 2012) [17] identified that interest rate, previous stock return levels, money supply and exchange rate are the main determinants of Nigerian stock returns. Some studies displayed that prediction of stock prices are not stimulated by macroeconomic factors. (Khatri, 2019) demonstrated that there is no significant influence of inflation, interest rate, gross domestic product, exchange rate, and foreign direct investment on the Nepalese stock price and concluded that the market was not efficient both in the long and short run. (Çakmakli & van Dijk, 2016) [4] used principal component analysis with 118 macroeconomic variables to design a model with small number of factors from a large set of macro variables and concluded that there is no positive association between equity returns of U.S. Stock and micro economic factors used in the study. Using a monthly data from April 1994 to July 2018, (Gopinathan & Durai, 2019) [7], find no long-run association between equity market and macroeconomic variables in India. (Abbas *et al*., 2014) [1] conduct a study on 10 years monthly data from 2002-2012 of Inflation, exchange rate, GDP, gold prices and T-bills rate and finds that there was no a positive correlation between these variables and Pakistan equity prices. (Wang *et al*., 2023) [22] investigate the shocks of internal and external macroeconomic factors on the response of BRICS stock prices, and revealed that no correlation existed between them. They find clear variations across countries, market states, and time horizons.

Further few papers discussed that equity returns can be forecasted by certain variables moderately. (Bilson *et al*., 2001) [3] conducted a study to find the explanatory power of local macroeconomic variables over stock returns in emerging markets and concluded that money supply, goods prices, real activity, and exchange rates have a moderate relationship with emerging equity returns. Employing monthly data over the period January 1992 to December 2008, an empirical study conducted by (M Kuwornu, 2011) [16] revealed a significant positive relationship between equity returns and the inflation rate, while the analysis displays a negative association with the exchange rate and Treasury bill rate. The arbitrage pricing theory and capital asset pricing model framework for monthly data were applied by (Ouma & Muriu, 2014) [18] to investigate the influence of macro-economic variables on stock returns in Kenya during the period 2003-2013 and the result shows exchange rate has a negative impact on equity prices while money supply and inflation are found to be significant determinants of the equity returns. Employing a method of panel data on 198 Indian listed stocks, (Chhajer *et al*., 2020) [5] evaluated the influence of total assets, debt-equity ratio, current ratio, return on equity

and dividend yield, and price to book value ratio on the stock returns. The authors conclude that return on equity and dividend yield affect stock returns. (Yadav *et al*., 2022) [23] analysed the effect of return on assets, earnings per share, leverage, and size on the stock returns of select banks in India on equity prices by using balanced panel regression and found that stock returns have been influenced significantly by the return on assets and earnings per share.

Model

This study uses the following model to analyze the relationship between SMI and fundamental economic variables

$$\text{lnifty500}_t = \beta_0 + \beta_1 \text{laum}_t + \beta_2 \text{lcpi}_t + \beta_3 \text{liip}_t + \beta_4 \text{lex}_t + \beta_5 \text{roi}_t + \varepsilon_t$$

Where lnifty500, laum, lcpi, liip, lex denote natural logs of Indian nifty500 index, assets under management, consumer price index, index of industrial production, USD-INR exchange rate and roi indicate three-month treasury bill rate in India. An increase in the industrial production index increases the firm's earnings, leading to an increase in the present value of the firm, which augments the stock market investment that causes higher SMI and vice-versa. A firm having higher AUM benefits from economies of scale, higher liquidity, and higher resources to invest in research and analysis that positively affect the fund's index. All the fund houses invest time and efforts to increase the AUM. However, AUM inversely affects the churning of funds in the stock market, i.e., a higher AUM makes it difficult for the fund managers to quickly and constantly keep buying and selling in massive amounts. Thus, larger funds sometimes see sluggish growth in returns. A decrease in the interest rate lowers the borrowing costs that boosts consumer and investment spending, which augments the share price and vice-versa. However, if an increase in interest rate is caused by increased income growth, the effect may not be negative. A higher inflation rate (Δlcpi) reduces investors' purchasing power, thus adversely affecting stock market investment and consequently the SMI. Fisher's model illustrates, on the other hand, the positive impact of inflation on SMI. If inflation is accompanied by growth, it can positively affect company's earnings and thus the SMI. The impact of the exchange rate on SMI depends on the degree of trade openness and trade balance of a country. An appreciation (depreciation) in the foreign currency increases (decreases) import costs for an economy that is heavily dependent on imports, thus decreasing (increasing) the share price.

Methods and Data Analysis

Secondary data is gathered for the NIFTY 500 index NAV, consumer price index (CPI), and industrial production index (IIP), USD-INR exchange rate, asset under management (AUM), and three-month Treasury bill rate of the Indian economy on a monthly basis from November 2005 to April 2024. The data for NIFTY 500 index is sourced from yahoo finance. The data for CPI for the Indian economy is collected from IMF database and the data for IIP (2011-12 base year) is sourced from RBI database. The USD-INR exchange rate and three month treasury bill rate of India is collected from St. Louis Federal Reserve database. The data for AUM is taken from AMFI data source. Table 1 below depicts how the variables are defined.

Table 1: Definition of variables

Symbol	Variable	Definition
LNIFTY500	SMI	Natural log of Nifty500 index
LAUM	Asset under management	Natural log of asset under management
LCPI	Inflation	Natural log of consumer price index
LIIP	Real Economic Activity	Natural log of index for industrial production
LEX	Exchange Rate	Natural log of USD-INR exchange rate
ROI	Rate of Interest	Monthly average of 91-day treasury bill rate

Δ is used to represent the first differences in variables, which indicate a change in the variables. For instance, Δlnifty500 represents stock market returns. The descriptive statistics of variables in first differences are given in Table 2. It may be seen from the table that while mean is highest for Δlaum and lowest for Δlex, standard deviation is maximal for Δroi and minimal for Δlcpi.

Table 2: Descriptive Statistics

Var.	Average	St. Dev.	Min.	Max.
Δroi	0.005219	0.5294321	-2.9325	3.7804
Δlnifty500	0.01	0.0652896	-0.3199997	0.2900004
Δlaum	0.0165499	0.0580095	-0.2758713	0.2687168
Δlcpi	0.0053567	0.0074575	-0.0447736	0.0160828
Δliip	0.0028978	0.0866882	-0.5052104	0.4650569
Δlex	0.0027196	0.0176169	-0.0435884	0.0656579

Table 3: Correlation Matrix

	Δroi	Δlaum	Δlcpi	Δliip	Δlex	Δlnifty500
Δroi	1					
Δlaum	-0.1356	1				
Δlcpi	0.0237	0.0222	1			
Δliip	0.6181	0.0081	-0.0236	1		
Δlex	0.0956	-0.4203	0.1166	0.0012	1	
Δlnifty500	-0.1322	0.941	0.0352	-0.0007	-0.4525	1

Table 3's correlation matrix displays a strong correlation between Δlnifty500 and Δ laum, and a moderate correlation between Δlnifty500 and Δlex.

Econometric Methodology

As followed in all-time series studies, the first step of our analysis begins with analyzing the stationarity of all the variables using Dickey-Fuller Generalized Least Squares (DF-GLS) test suggested by (Elliott *et al*., 1996) [6]. Final Prediction Error (FPE) and Akaike's Information Criterion (AIC) are used in the second step to determine the optimal lag of VAR. Thereafter, this study uses (Johansen, 1991) [10] cointegration test to determine the existence of long run relationship between the variables. In the final step, VECM is used in order to ascertain the existence of short run relationship between the variables.

Results and Discussion

The findings of the stationarity test shown in Table 3 indicate that all the variables are non-stationary in levels and stationary in first differences, which shows that all the variables are I(1).

Table 3.1: Results of Stationarity test

Variable	DF-GLS Test Statistic	DF-GLS Inference
lnifty500	-3.275	Non-stationary
laum	-1.93	Non-stationary
lcpi	-0.861	Non-stationary
liip	-2.5	Non-stationary
lex	-2.306	Non-stationary
roi	-2.203	Non-stationary
Δlnifty500	-8.724	Stationary
Δlaum	-8.683	Stationary
Δlcpi	-4.859	Stationary
Δliip	-6.733	Stationary
Δroi	-10.436	Stationary
Δlex	-6.733	Stationary
Crit. val.		
10%	-2.634	
5%	-2.923	
1%	-3.48	

Table 4: Lag order of VAR model

Lags	Loglik	LR	p(LR)	FPE	Aic	Hqc	Sbic
1	2384.84	4554.5	0	1.90E-17	-21.4939	-21.2306	-20.8419*
2	2449.46	129.23	0	1.40E-17	-21.7565	-21.2673*	-20.5455
3	2488.59	78.267	0	1.40E-17*	-21.7852*	-21.0703	-20.0153
4	2515.41	53.562*	0.029	1.50E-17	-21.701	-20.7604	-19.3722

Table 5: Johansen Cointegration Test

Rank	LL	Eigenvalue	Trace Test	Crit. Val.
0	2436.104		112.7195	94.15
1	2458.2418	0.18305	68.4439*	68.52
2	2472.7967	0.12447	39.3341	47.21
3	2483.8254	0.09581	17.2767	29.68
4	2488.7556	0.04411	7.3963	15.41
5	2491.8326	0.02762	1.2623	3.76
6	2492.4638	0.00575		

As shown in Table 4, the optimal lag of VAR model is 3 on the basis of AIC and HQIC criteria. Further, Table 5 reveals that the null hypothesis of absence of cointegration is rejected and the null hypothesis that there is atmost one cointegrating vector is not rejected. The long-run cointegrating equation with lnifty500 as the dependent variable is shown below:

Lnifty 500 = 1.316636 + 0.4238 laum + 0.5564lcpi + 0.0238 liip-0.1187lex + 0.0147roi (11.07)*** (4.16)*** (0.29) (-1.01), (1.44)

***indicates significance at 1%. Values in brackets indicate t-ratio.

The coefficients of the variables are normalized coefficients and except roi, they represent the elasticities of SMI with respect to the explanatory variables.

As shown in the above estimated co-integrating equation, we find positive and significant linkage between AUM and NIFTY500 index in the long run. It is noteworthy that positive returns of the markets as displayed by NIFTY500 index has started attracting more investors towards the markets thereby resulting in an increase in AUM for all fund houses and vice versa. This move in favour of stock markets is encouraging for an emerging country like India as the country is moving towards higher investment levels. However, the same relationship at the time of market downturns reflects the need for better investment understanding and in-depth analysis by investors. The present study limits its findings to this positive relationship but the same can be explored further.

We find positive and significant impact of CPI on NIFTY500 index. The Fisher's model's explanation of a positive association between SMI and inflation is in line with this result. A steady inflation is accompanied by economic growth that creates overall good environment for stocks. Thus, inflation can affect SMI positively in the long run. Our results

indicate that in long run, IIP has positive but insignificant effect on SMI. Further, we find that exchange rate has an inverse and significant relationship with the SMI in the long run. The exchange rate and the SMI have a significant and inverse linkage, which is in accordance with the 'Flow-oriented theory'. As explained in Suri *et al*. (2024), for a less export-oriented firm, a depreciation of domestic currency increases the cost of imports that adversely affects firm's profitability and stock prices. Further, we find that the rate of interest has a positive but insignificant effect on the SMI.

If the variables are cointegrated, the next step is to calculate the VECM (Table 6) that explains the short-term dynamics of the endogenous variables towards their equilibrium values.

Table 6: Results of VECM

Dependent Variable: Δlnifty500t		
Variable	**Coefficient**	**T-Value**
ECT_{t-1}	-0.1578	-2.44**
$\Delta lnifty500_{t-1}$.	-0.3299	-1.43
$\Delta lnifty500_{t-2}$	0.1791	0.83
$\Delta laui_{t-1}$	0.5045	1.91*
$\Delta laui_{t-2}$	-0.2901	-1.16
Δroi_{t-1}	0.0126	1.15
Δroi_{t-2}	0.0076	0.69
$\Delta lcpi_{t-1}$	-0.0873	-0.14
$\Delta lcpi_{t-2}$	-0.0241	-0.04
$\Delta liip_{t-1}$	-0.0284	-0.41
$\Delta liip_{t-2}$	0.068	0.94
Δlex_{t-1}	-0.6769	-2.17**
Δlex_{t-2}	-0.0005	0
Constant	0.0089	1.57

Note: *,**, *** denote 10%, 5% and 1% LoS respectively.

Table 6 reveals that the estimated error correction term (ECT) is negative and significant at 10% LOS. It can be inferred that the long-term association between the SMI and explanatory variables is stable and converging. According to the ECT's estimated coefficient, each period will correct 15.78% of any previous disequilibrium in the long run. Further, VECM estimates given in Table 6 indicate that stock market returns are affected significantly negative by one period earlier changes in the exchange rate. This result signifies that the depreciation (appreciation) of exchange rate one period earlier causes a decrease (increase) in the SMI in the current period. We find that stock market returns are positively and significantly affected by one period earlier changes in AUM. Besides exchange rate and AUM, all other variables in this study do not have a significant impact on stock market returns in the short-term, according to our findings. The diagnostic tests indicate that the null hypothesis of no autocorrelation cannot be rejected at lag 4 ($\varkappa^2$ statistic at lag 4 is 30.3815 with P-value 0.7325) and that the number of cointegrating equations is correctly specified.

Conclusion

This study examines the variables that affect SMI in India. In particular, we analyze the interaction between the SMI, AUM, CPI, IIP, rate of interest, and USD-INR exchange rate for India. For this purpose, we utilize the monthly data of NIFTY500 index, AUM, rate of interest, IIP, USD-INR exchange rate and CPI from November 2005 to April 2024. We use (Johansen, 1991) [10] cointegration technique to examine the long run relationship between these variables. The short-term relationship between the selected variables under this study is analyzed by estimating the VECM.

As per the Johansen cointegration test findings, there is a long-term correlation between the SMI, AUM, and other fundamental economic variables, specifically, CPI, IIP, USD -INR exchange rate and the rate of interest in India. The normalized coefficients of the cointegrating vector suggest that while AUM positively and significantly influence nifty500 index, the exchange rate has an inverse and significant relationship with it. Additionally, our results indicate that in the long run, except exchange rate and AUM, no variable significantly affect nifty500 index . Further, VECM results indicate that the ECT is negative and significant that indicates a stable and converging equilibrium in the long run. Our results reveal that one period earlier change in the exchange rate and AUM significantly affect nifty500 returns in the current period. Moreover, results of an emerging economy like India can add to the understanding about other emerging markets too.

Investors, academicians, fund managers, and practitioners will have a significant advantage from the outcomes of this study. The study's results can be used to forecast the SMI in India, which can aid in making better investment decisions.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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